STORMWATER CALCULATIONS

Bibb and associates
A KIEWIT COMPANY

CALCULATIONS COVER SHEET

PROJECT NAME: Bullard Energy Center

BIBB PROJECT NO. 2006026

CALC NO.

DISCIPLINE: Civil

TITLE: Detention Basin

SCOPE:

ASSUMPTIONS: SEE ATTACHED

REFERENCES: SEE ATTACHED

RESULTS: SEE ATTACHED

Rev.	Prepared by	Date	Checked by	Date
	Andy Noll & Daniel Snead	9/5/2006	Omar Olivares	9/7/2006

Precipitation Frequency Data Output

NOAA Atlas 2
California 36.820833?N 119.8988?W
Site-specific Estimates

Map	Precipitation (inches)	Precipitation Intensity (in/hr)
2-year 6-hour	0.94	0.16
2-year 24-hour	1.37	0.06
100-year 6-hour	1.88	0.31
100-year 24-hour	2.63	0.11

Bollard Energy

10 yr = 1.9 in
5 yr = 1.75 in

Hydrometeorological Design Studies Center - NOAA/National Weather Service
1325 East-West Highway - Silver Spring, MD 20910 - (301) 713-1669
Wed Jul 5 16:33:20 2006

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Water Features

Eastern Fresno Area, California

Depths of layers are in feet. See text for definitions of terms used in this table. Estimates of the frequency of ponding and flooding apply to the whole year rather than to individual months. Absence of an entry indicates that the feature is not a concern or that data were not estimated. This report shows only the major soils in each map unit.

Map symbol and soil name	Hydrologic group	Surface runoff	Months	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
				Ft	Ft	Ft				
Es:										
EXETER	C	Medium	Jan-Dec			---	---	None	---	None

Ponds and Embankments (CA)

Eastern Fresno Area, California

[[The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The table shows only the top limitations for any given soil. The soil may have additional limitations]. This report shows only the major soils in each map unit]

Map symbol and soil name	Pct. of map unit	Pond Reservoir Area (CA)		Embankments, Dikes, and Levees (CA)		Excavated Ponds (Aquifer-fed)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
Es:							
EXETER	85	Limitations		Limitations		Very limited	
		Depth to pan 20 to 60"	0.86	Thin layer	0.86	Depth to water	1.00
		Permeability .6-2"/hr (some seepage)	0.50				

Engineering Properties

Eastern Fresno Area, California

[Absence of an entry indicates that the data were not estimated. This report shows only the major soils in each map unit]

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percent passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
Es:												
EXETER	0-15	Sandy loam	SC-SM, SM	A-4	0	0	100	95-100	50-70	35-50	15-25	NP-5
	15-30	Sandy clay loam, sandy loam	SC, SC-SM	A-4, A-6	0	0	100	95-100	70-90	35-50	25-35	5-15
	30-34	Cemented	---	---	---	---	---	---	---	---	---	---

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Physical Soil Properties

Eastern Fresno Area, California

[Entries under 'Erosion Factors--T' apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of an entry indicates that data were not estimated. This report shows only the major soils in each map unit]

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
Es:														
EXETER	0-15	---	---	10-20	1.50-1.60	4.00-14.00	0.10-0.13	0.0-2.9	0.0-1.0	.32	.24	2	3	86
	15-30	---	---	18-25	1.40-1.50	4.00-14.00	0.14-0.17	0.0-2.9	0.0-0.5	.32	.32			
	30-34	---	---	---	---	0.01-0.10	0.00	---	---	---	---			

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Exhibit 4-1 Unit peak discharge (q_u) for NRCS (SCS) type I rainfall distribution

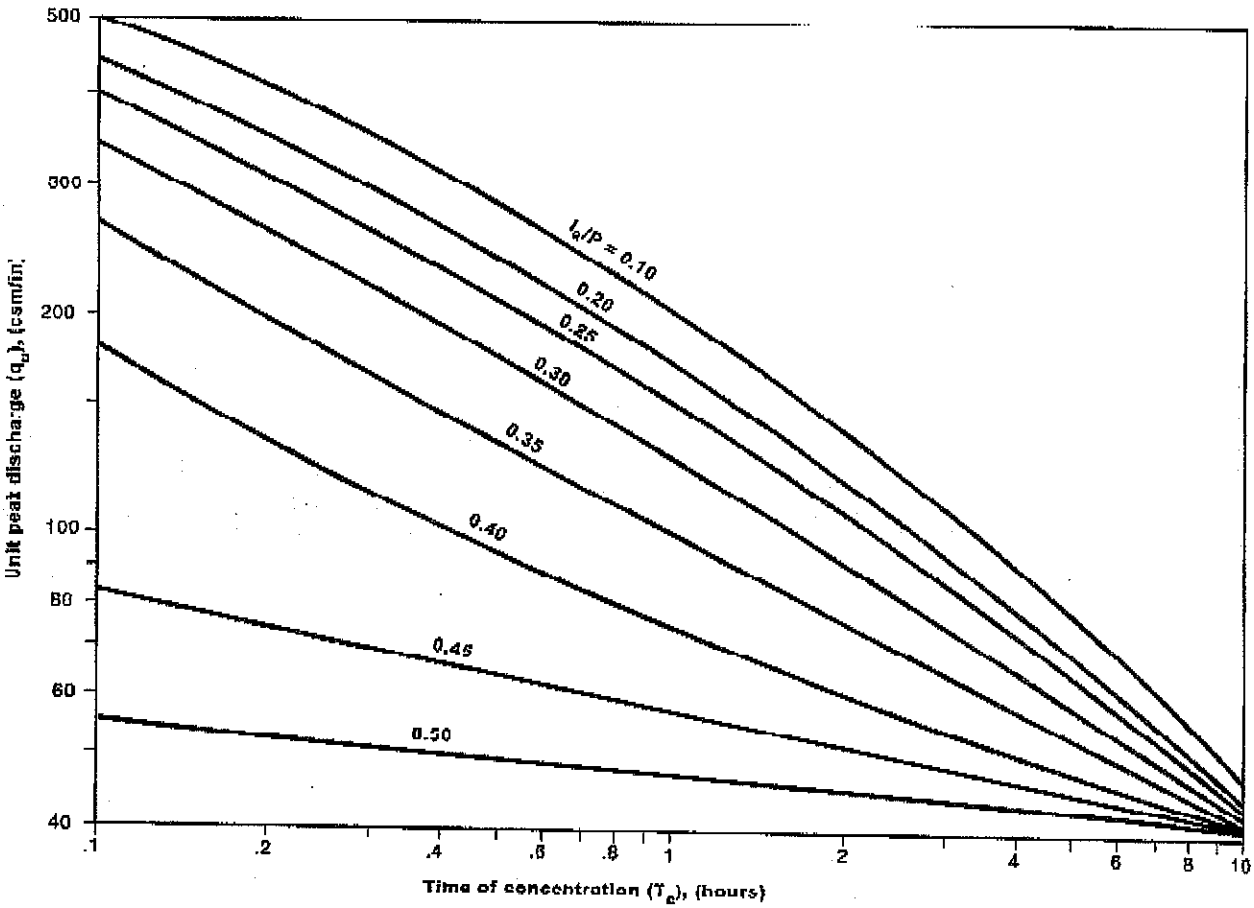
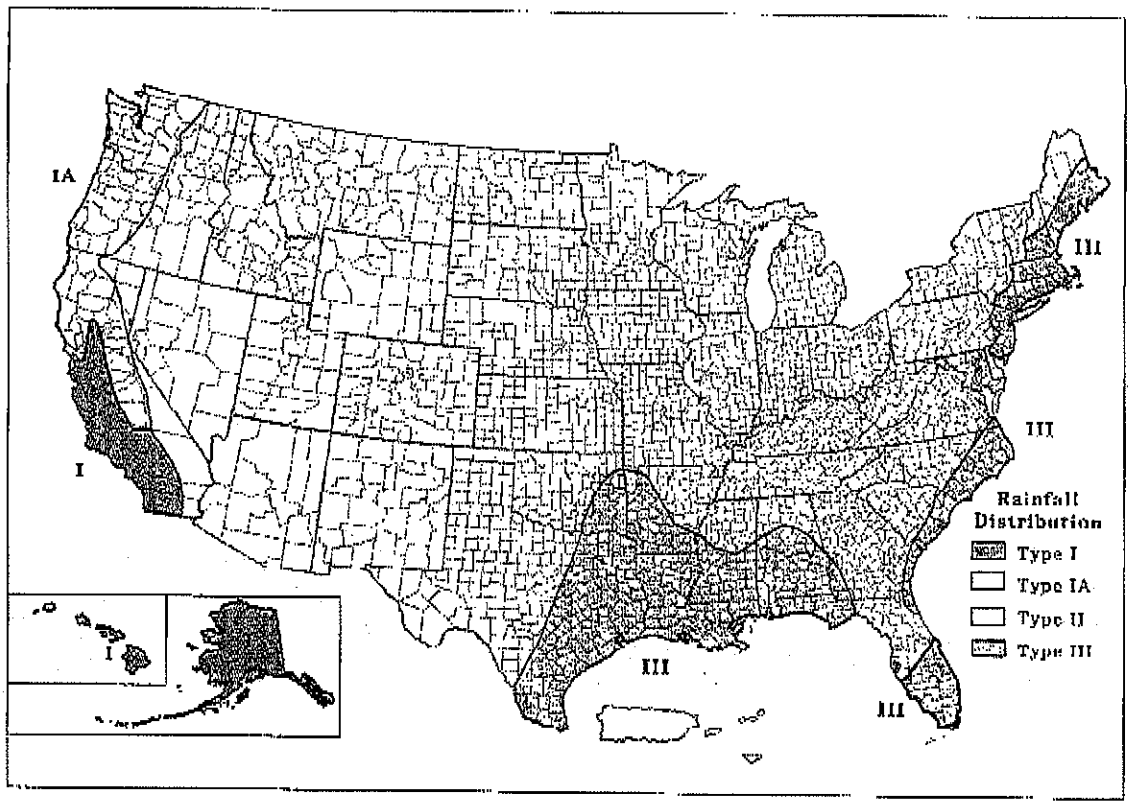


Figure B 2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

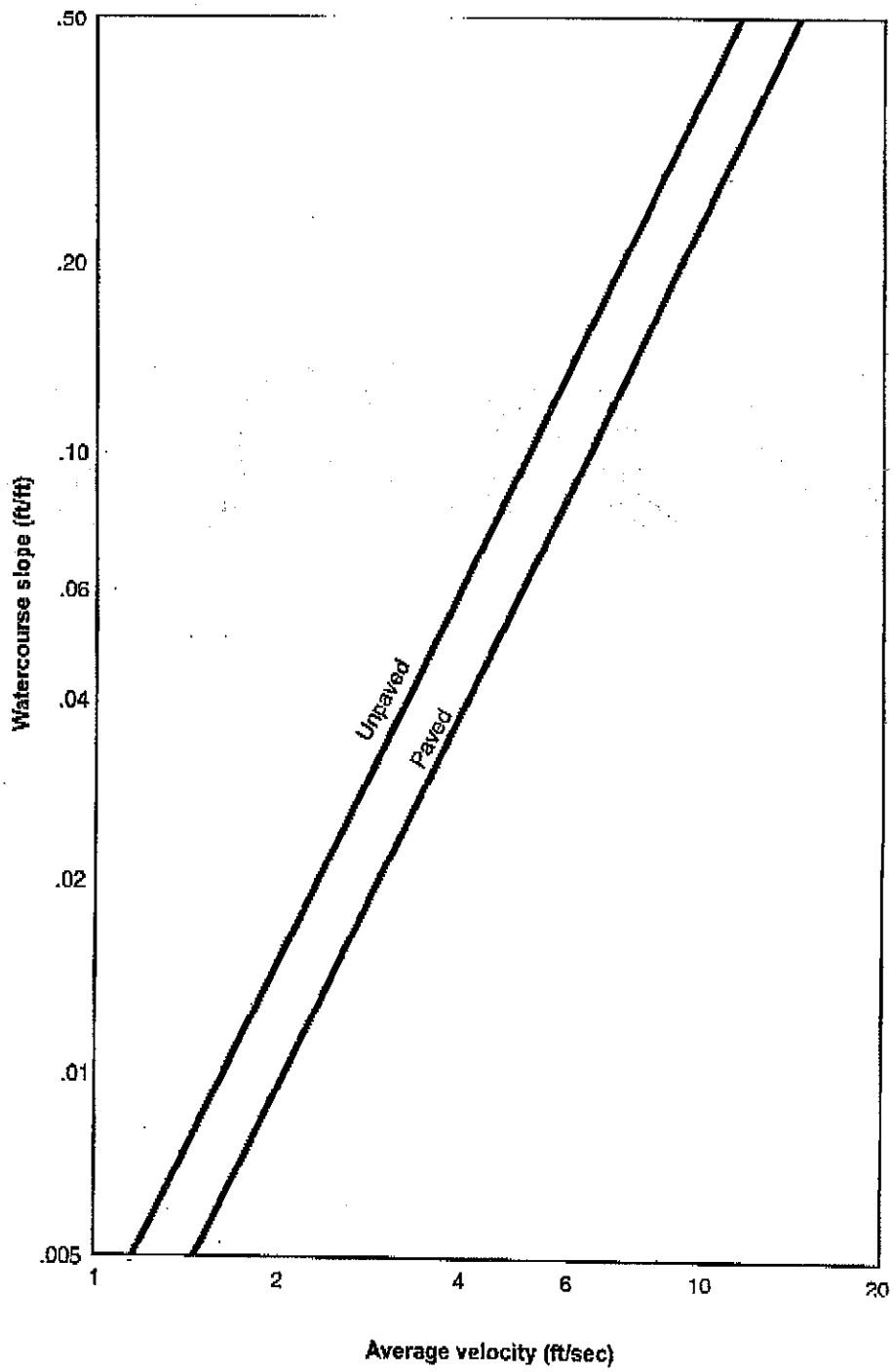
Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow



Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	SCS Runoff	2.168	1	604	16,400	----	------	------	Predevelopment
3	SCS Runoff	4.513	1	599	23,282	----	------	------	Post Development
4	Reservoir	0.506	1	736	15,521	3	10.59	9,141	Pond

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Prelim Pond Sizing 9-6-06.gpw	Return Period: 2 Year	Wednesday, Sep 6 2006, 11:48 AM

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	SCS Runoff	4.134	1	604	27,226	----	-----	----	Predevelopment
3	SCS Runoff	7.355	1	599	35,920	---	------	------	Post Development
4	Reservoir	1.440	1	630	28,160	3	10.67	10,559	Pond

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Prelim Pond Sizing 9-6-06.gpw	Return Period: 5 Year	Wednesday, Sep 6 2006, 11:48 AM

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	SCS Runoff	4.985	1	604	31,874	----	------	------	Predevelopment
3	SCS Runoff	8.540	1	599	41,193	----	------	------	Post Development
4	Reservoir	2.187	1	616	33,432	3	10.73	11,474	Pond

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Prelim Pond Sizing 9-6-06.gpw	Return Period: 10 Year	Wednesday, Sep 6 2006, 11:48 AM

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	SCS Runoff	9.570	1	603	56,580	----	------	------	Predevelopment
3	SCS Runoff	14.61	1	599	68,345	----	------	------	Post Development
4	Reservoir	7.899	1	606	60,584	3	11.05	16,917	Pond

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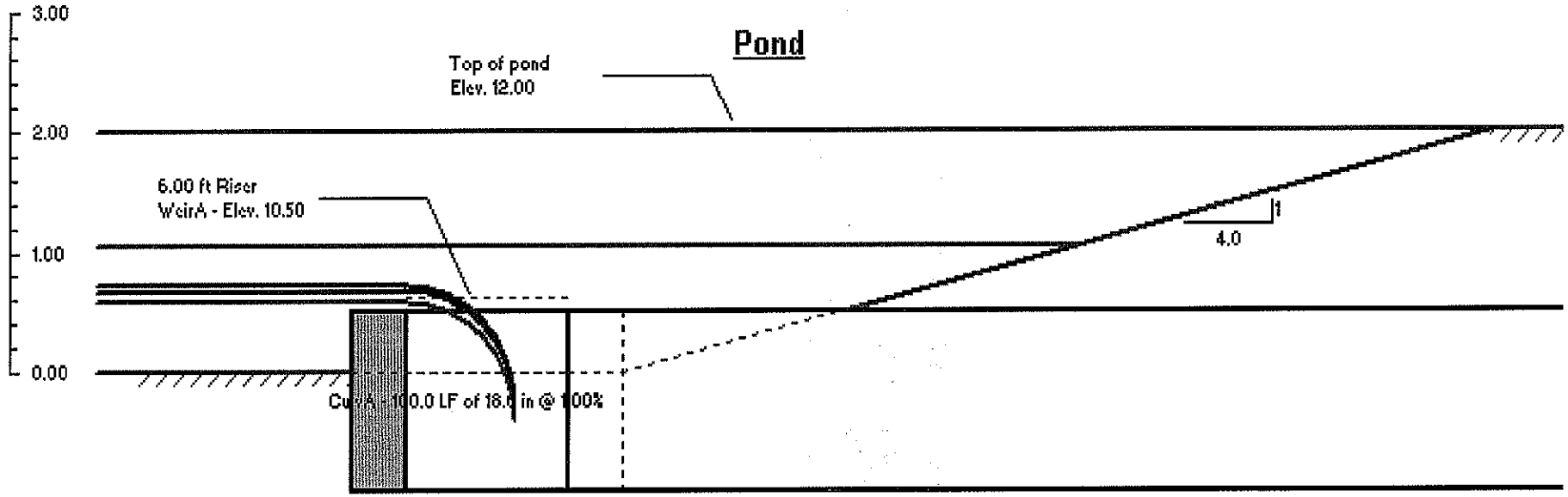
Prelim Pond Sizing 9-6-06.gpw	Return Period: 100 Year	Wednesday, Sep 6 2006, 11:48 AM



Section

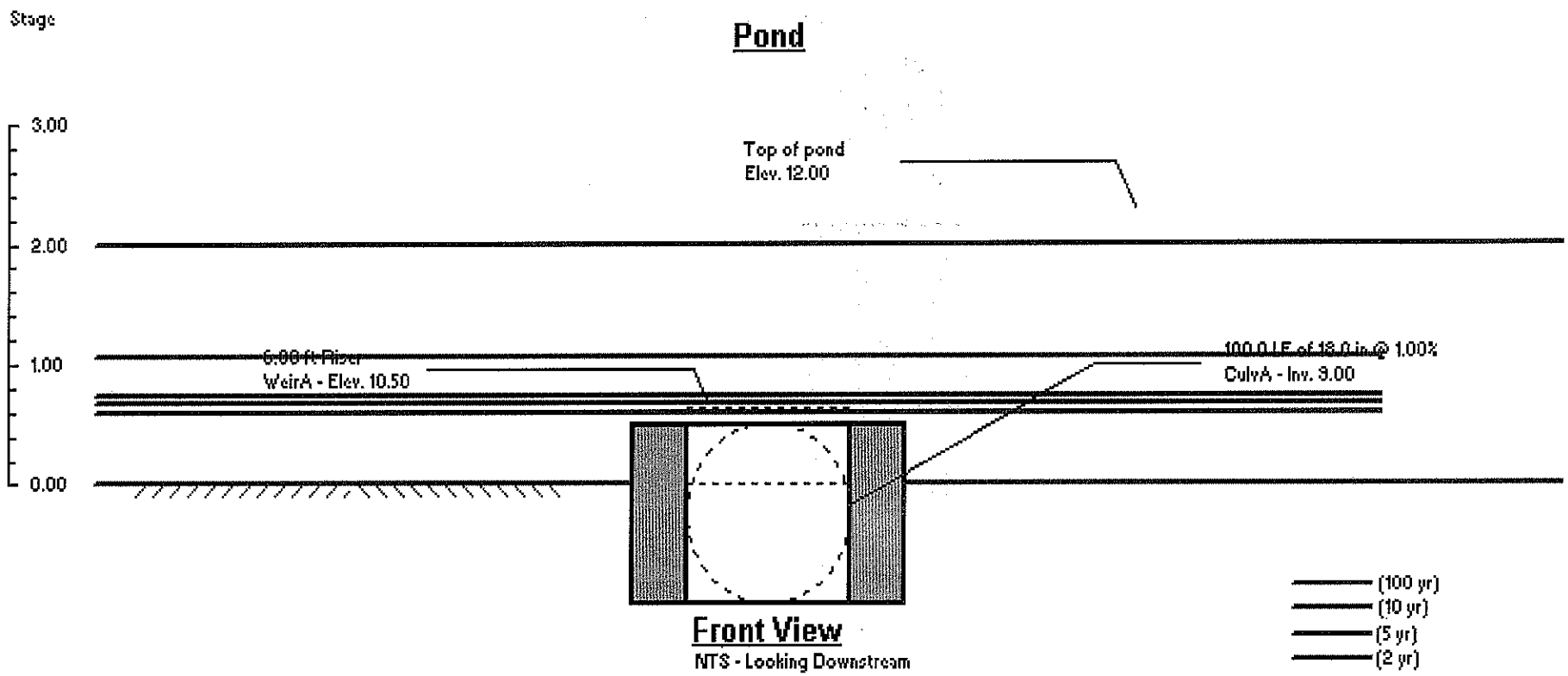
NTS

(100 yr)
(10 yr)
(5 yr)
(2 yr)

(14)

Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: Prelim Pond Sizing 9-6-06.gpw	Wednesday, Sep 6 2006, 11:46 AM



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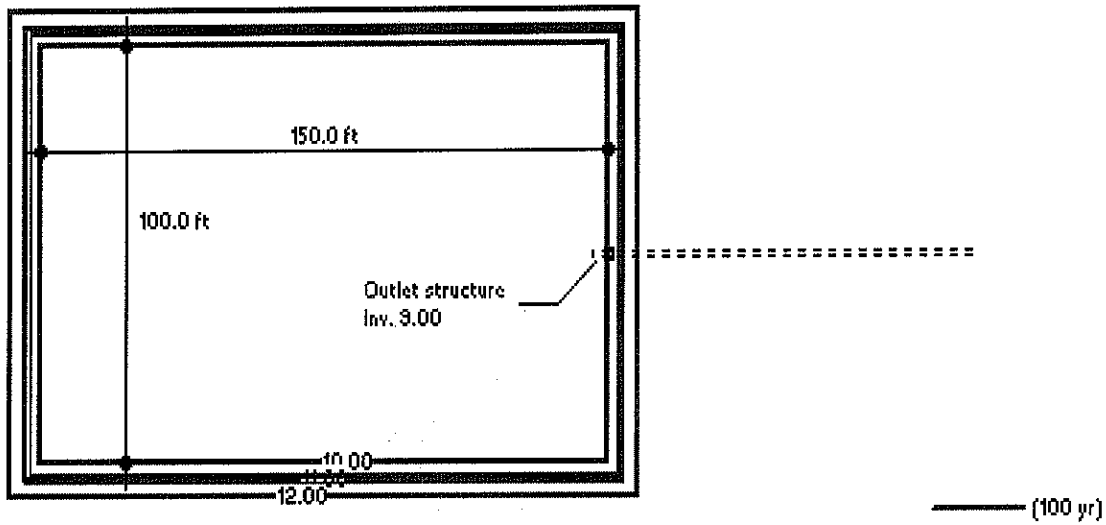
Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: Prelim Pond Sizing 9-6-06.gpw	Wednesday, Sep 6 2006, 11:47 AM

Pond



Plan View

NTS

Schematic only. Not for construction.

Hydraflow Hydrographs Pond Draw	Project: Prelim Pond Sizing 9-6-06.gpw	Wednesday, Sep 6 2006, 11:47 AM

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

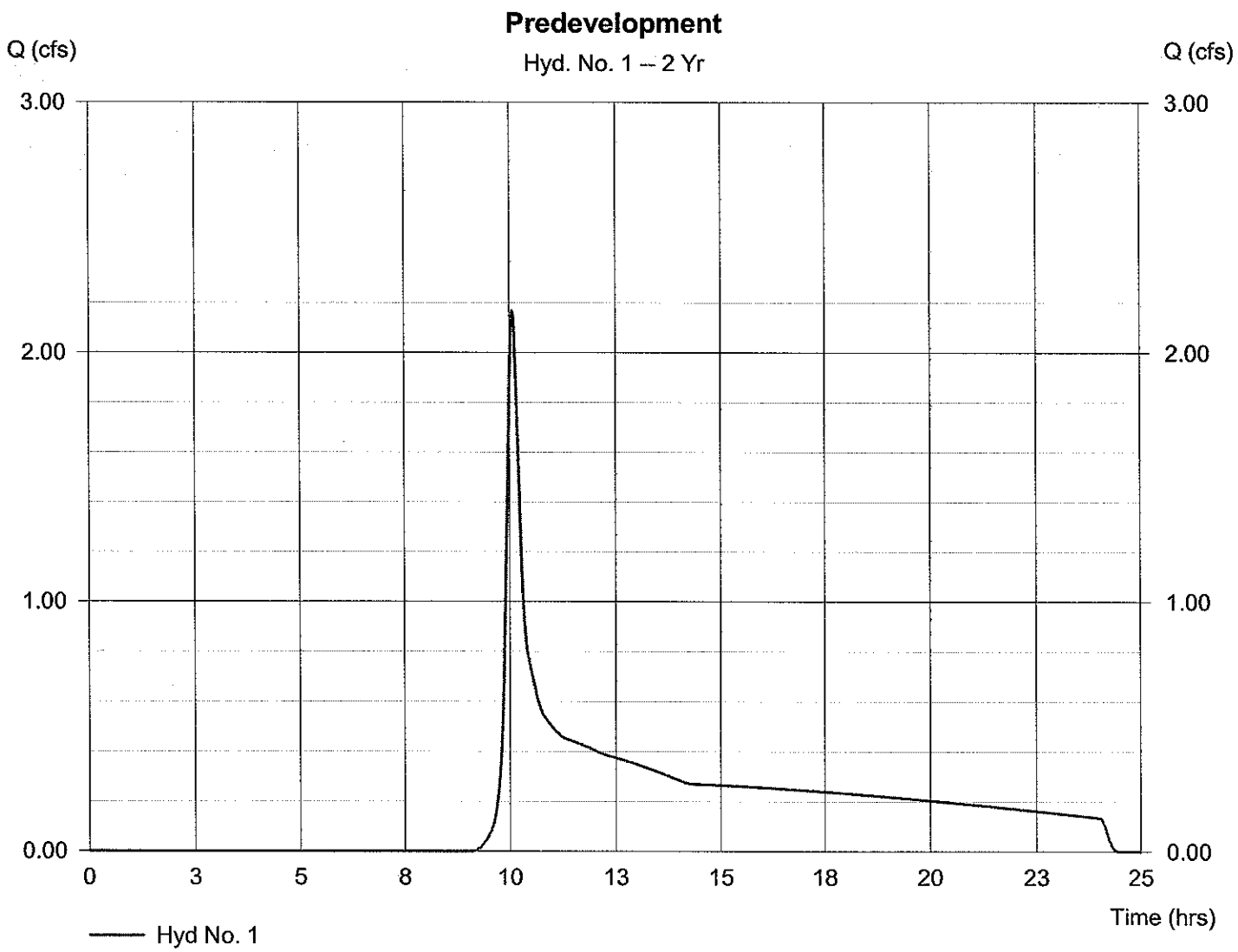
Wednesday, Sep 6 2006, 8:30 AM

Hyd. No. 1

Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 2.168 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 12.000 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 16.50 min
Total precip.	= 1.37 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 16,400 cuft



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Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

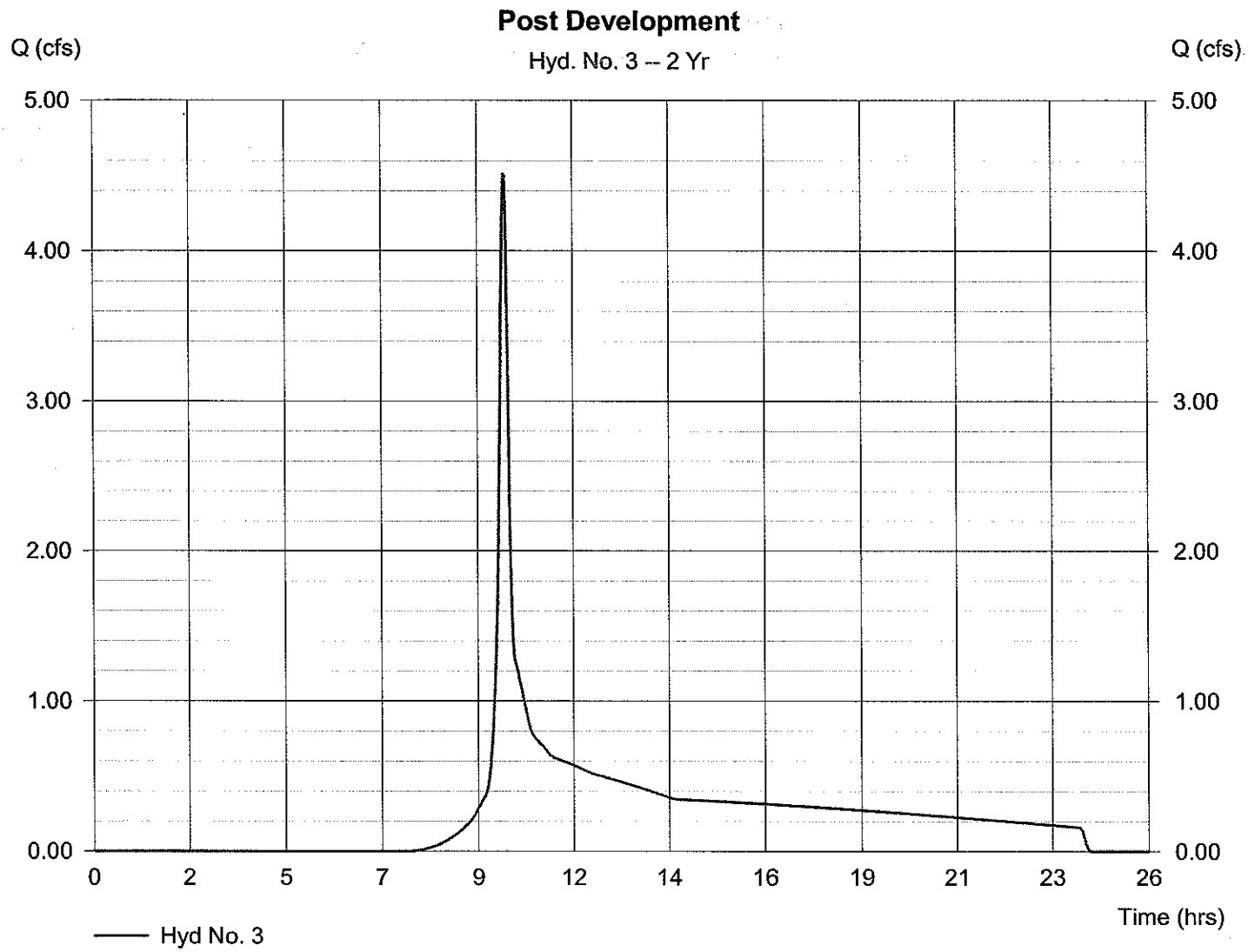
Wednesday, Sep 6 2006, 8:30 AM

Hyd. No. 3

Post Development

Hydrograph type	= SCS Runoff	Peak discharge	= 4.513 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Drainage area	= 12.000 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.00 min
Total precip.	= 1.37 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 23,282 cuft



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Hydrograph Plot

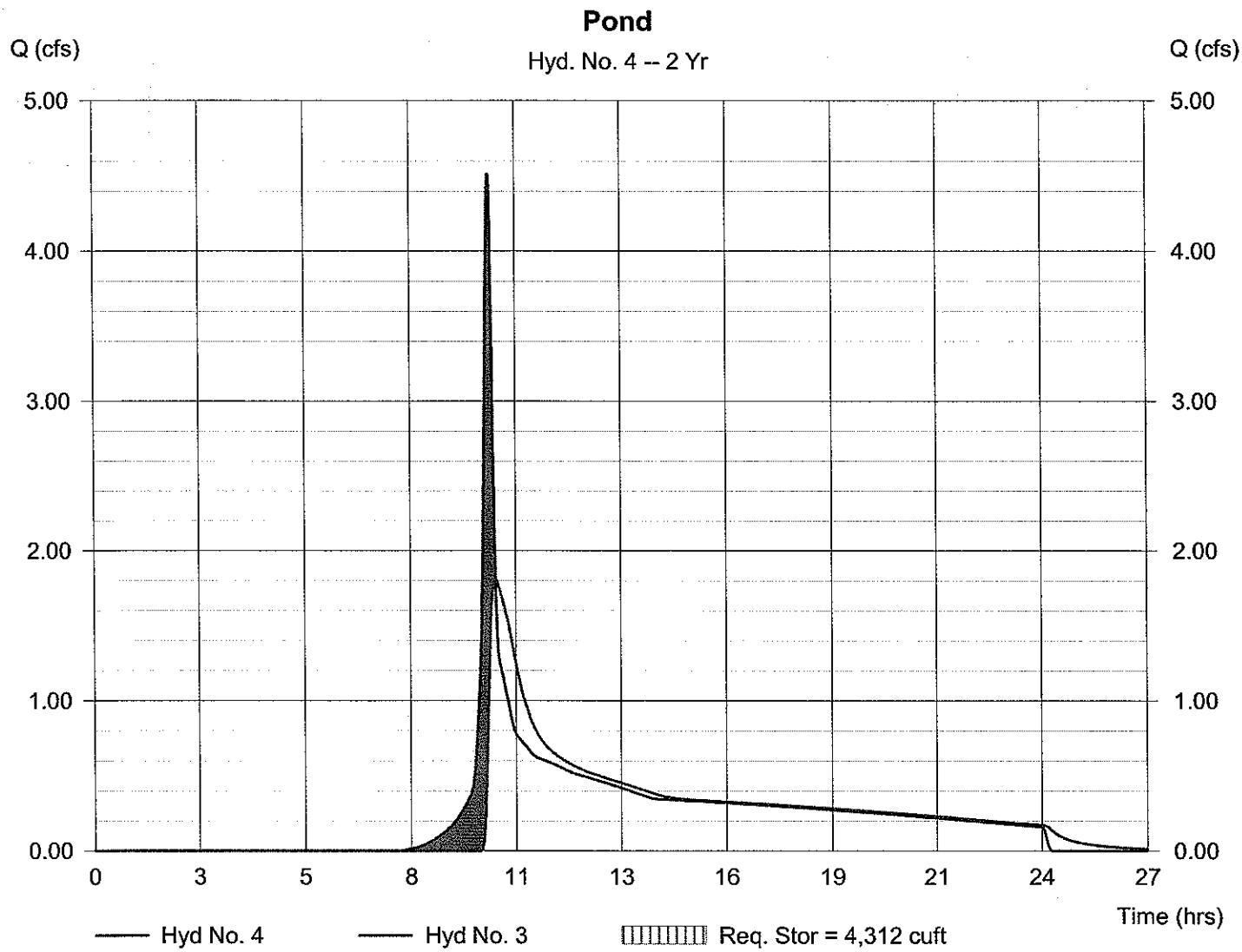
Hydraflow Hydrographs by Intelisolve | Wednesday, Sep 6 2006, 8:28 AM

Hyd. No. 4

Pond

Hydrograph type	= Reservoir	Peak discharge	= 1.809 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 11.39 ft
Reservoir name	= Pond	Max. Storage	= 4,312 cuft

Storage Indication method used. | Hydrograph Volume = 21,890 cuft



Hydrograph Plot

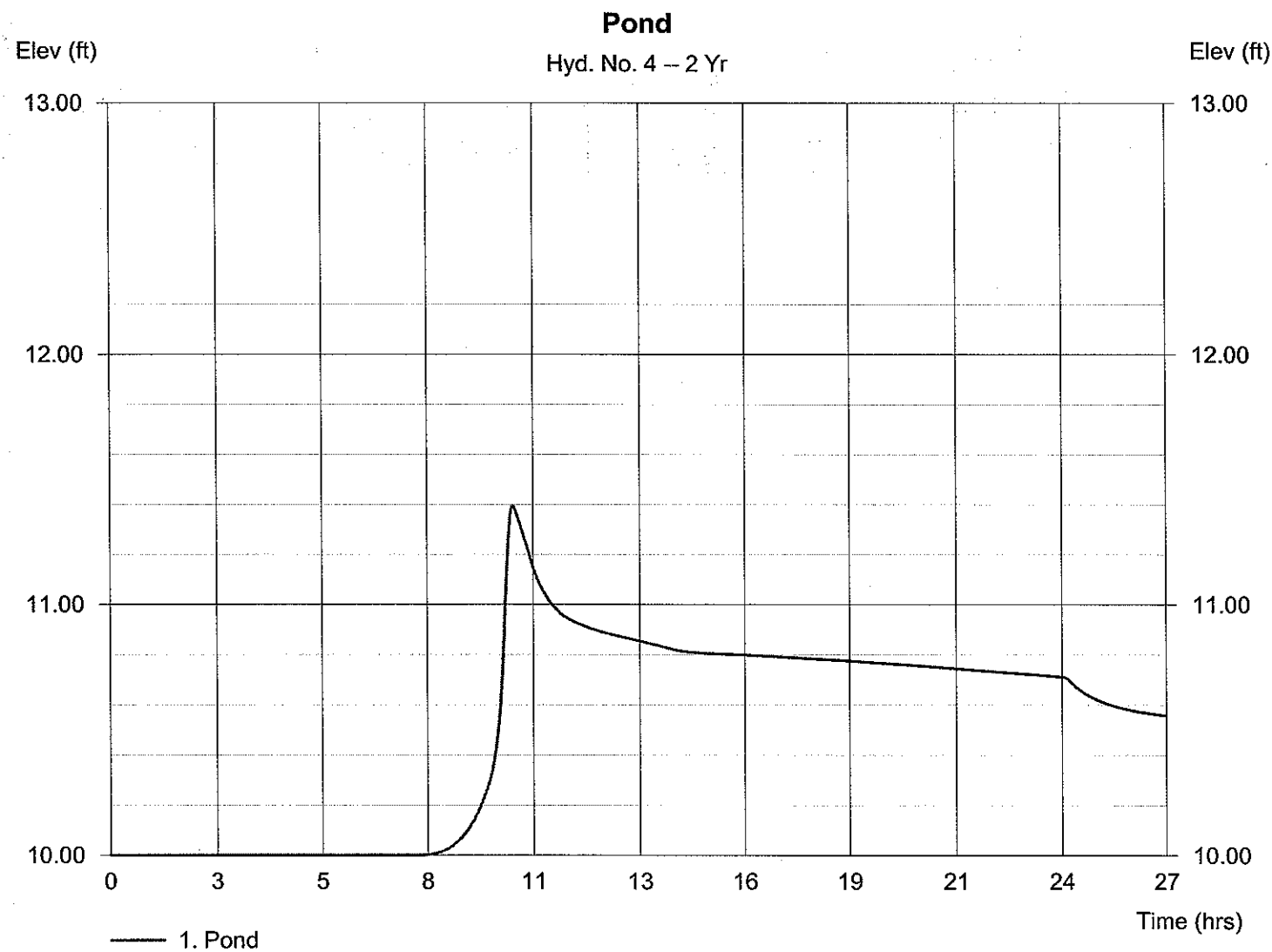
Hydraflow Hydrographs by Intelisolve | Wednesday, Sep 6 2006, 8:28 AM

Hyd. No. 4

Pond

Hydrograph type	= Reservoir	Peak discharge	= 1.809 cfs
Storm frequency	= 2 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 11.39 ft
Reservoir name	= Pond	Max. Storage	= 4,312 cuft

Storage Indication method used. | Hydrograph Volume = 21,890 cuft



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Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

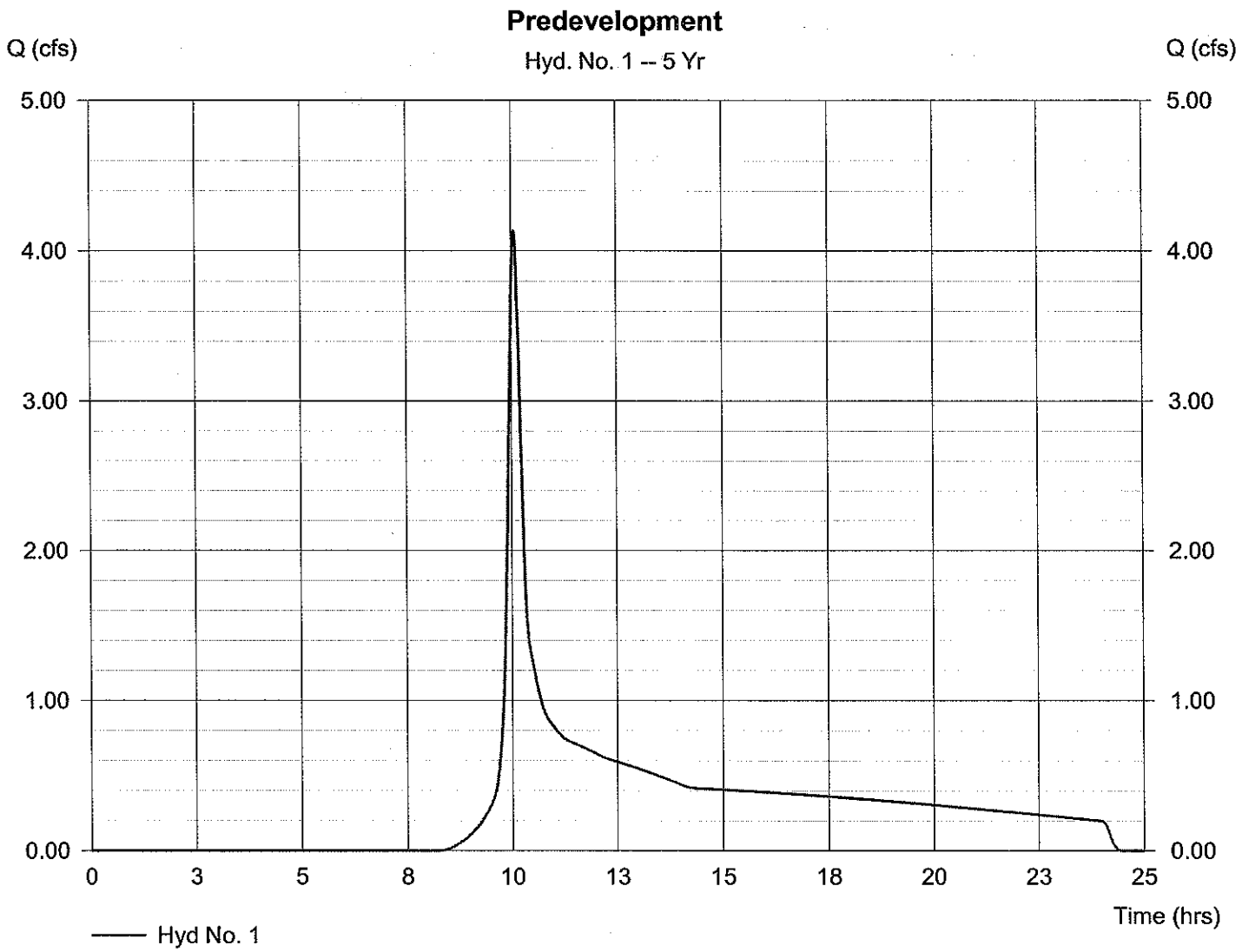
Wednesday, Sep 6 2006, 8:30 AM

Hyd. No. 1

Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 4.134 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Drainage area	= 12.000 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 16.50 min
Total precip.	= 1.75 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 27,226 cuft



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Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

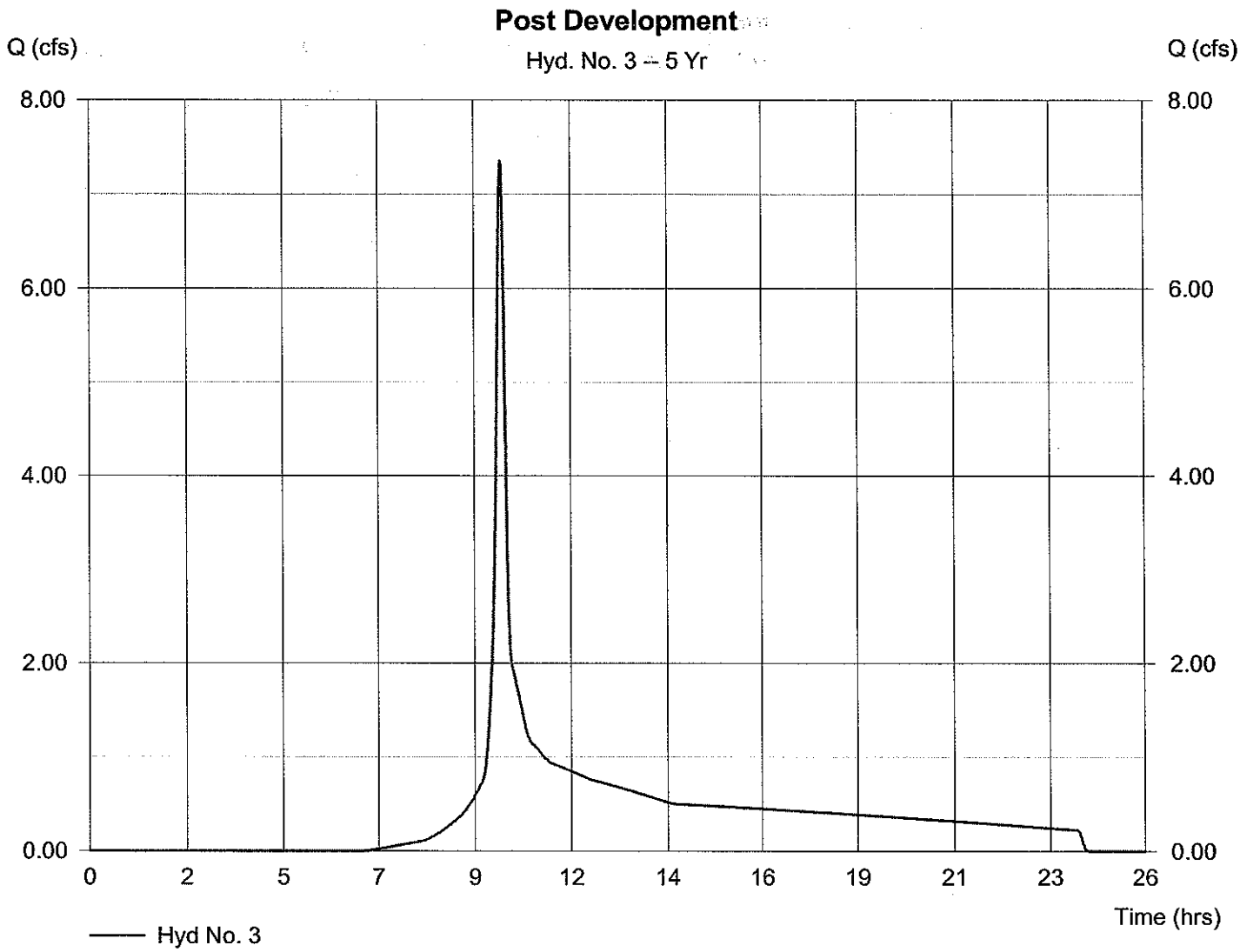
Wednesday, Sep 6 2006, 8:30 AM

Hyd. No. 3

Post Development

Hydrograph type	= SCS Runoff	Peak discharge	= 7.355 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Drainage area	= 12.000 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.00 min
Total precip.	= 1.75 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 35,920 cuft



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Hydrograph Plot

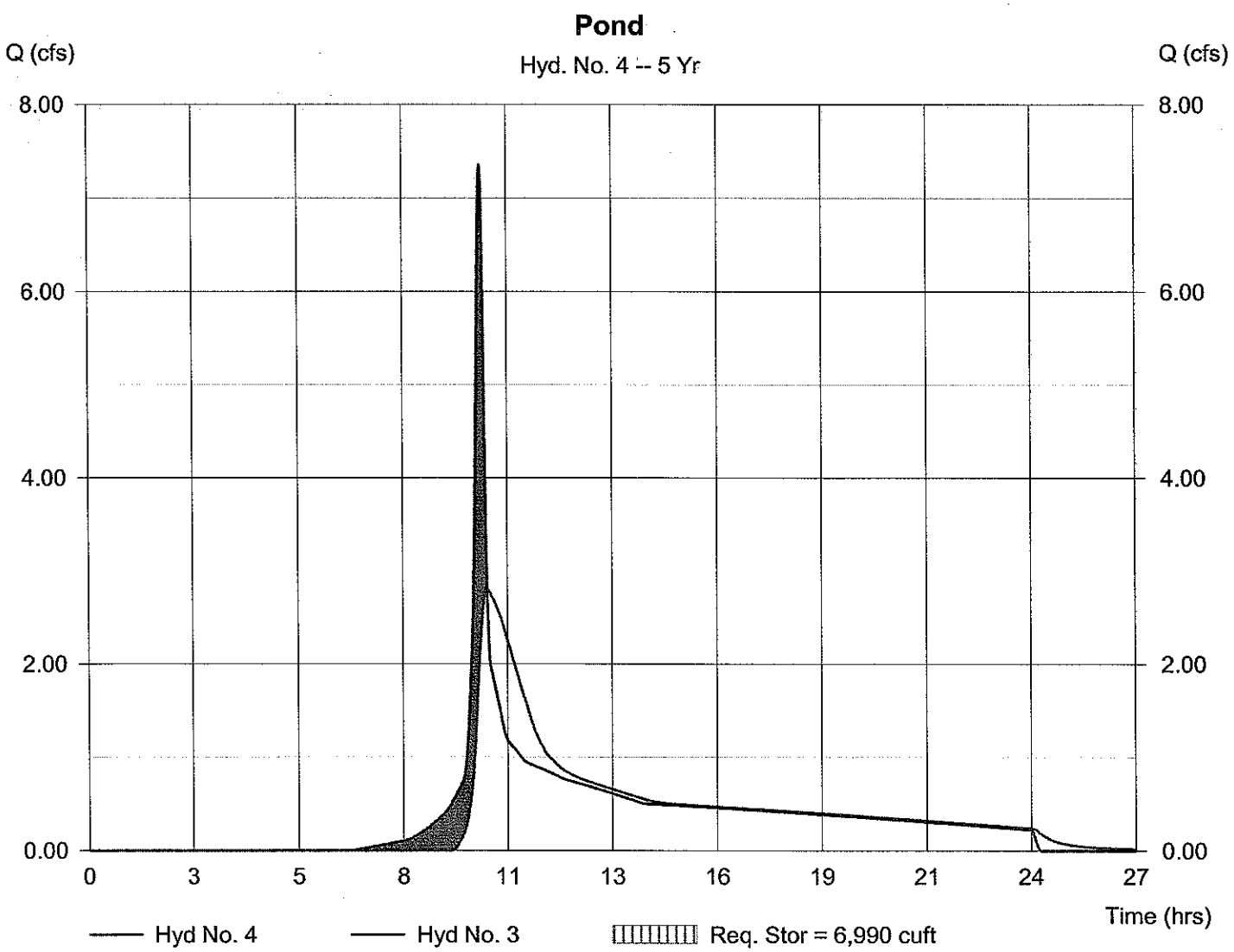
Hydraflow Hydrographs by Intelisolve | Wednesday, Sep 6 2006, 8:28 AM

Hyd. No. 4

Pond

Hydrograph type	= Reservoir	Peak discharge	= 2.794 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 12.05 ft
Reservoir name	= Pond	Max. Storage	= 6,990 cuft

Storage Indication method used. | Hydrograph Volume = 34,529 cuft



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Hydrograph Plot

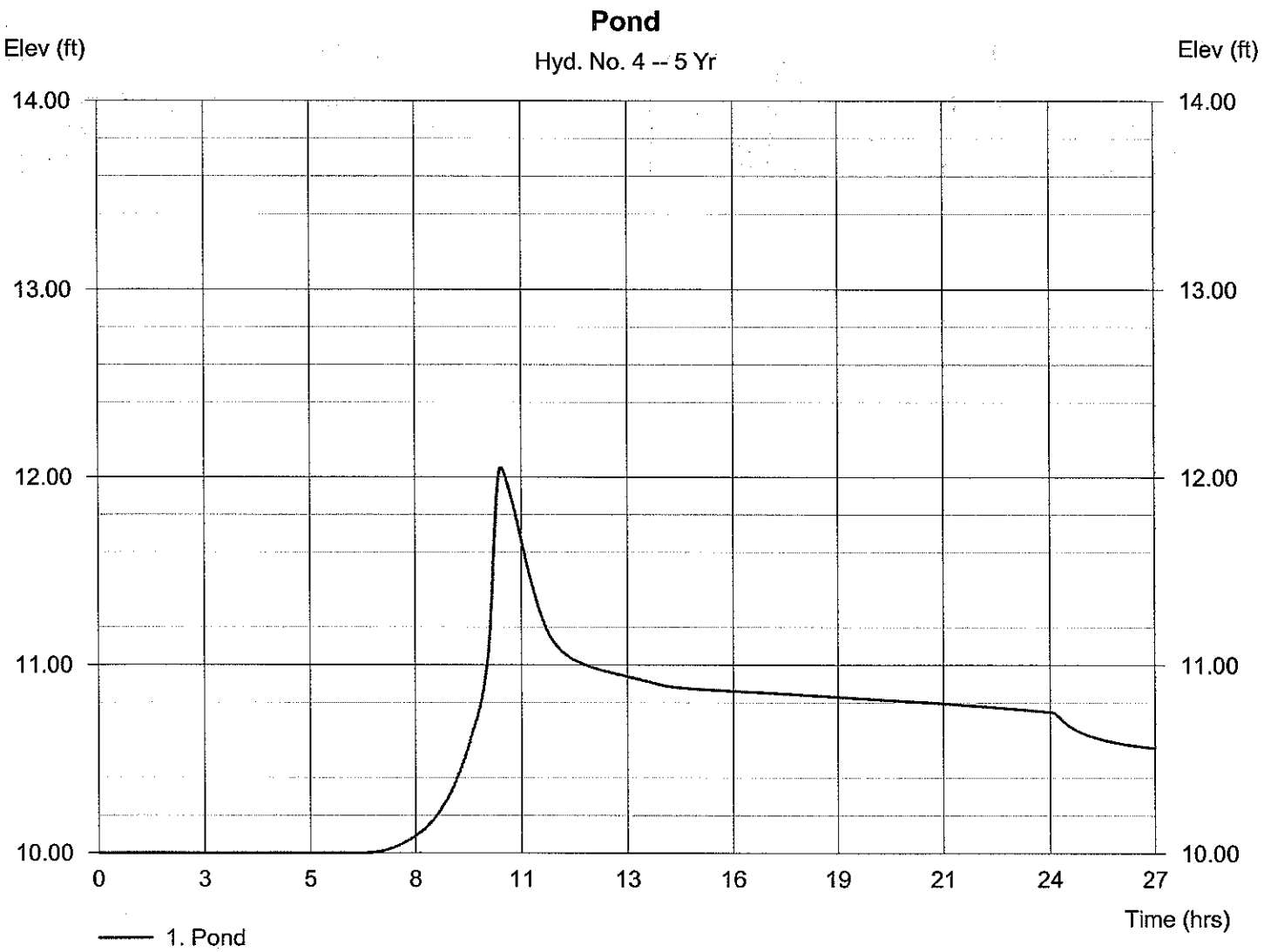
Hydraflow Hydrographs by Intelisolve | Wednesday, Sep 6 2006, 8:28 AM

Hyd. No. 4

Pond

Hydrograph type	= Reservoir	Peak discharge	= 2.794 cfs
Storm frequency	= 5 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 12.05 ft
Reservoir name	= Pond	Max. Storage	= 6,990 cuft

Storage Indication method used. | Hydrograph Volume = 34,529 cuft



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Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

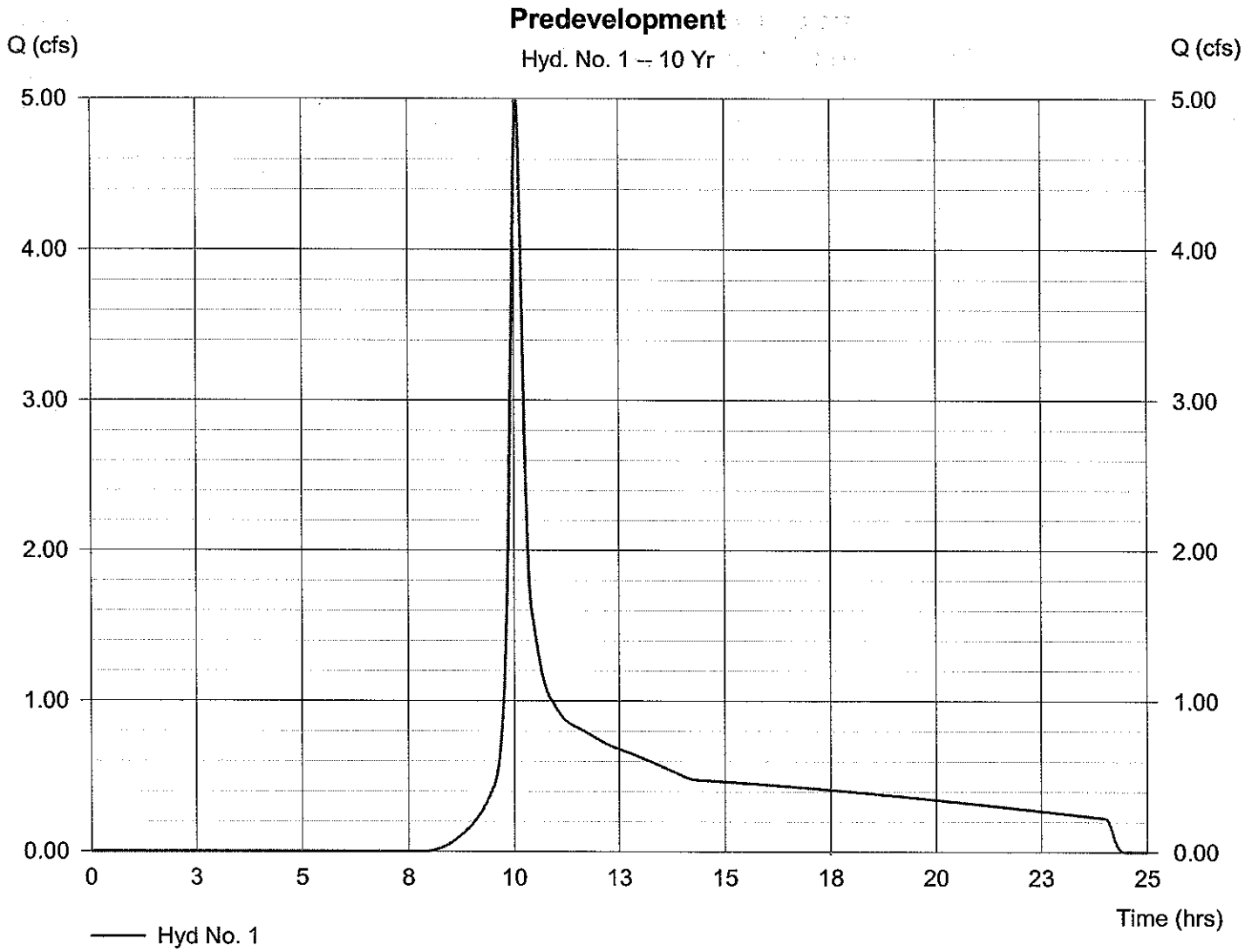
Wednesday, Sep 6 2006, 8:30 AM

Hyd. No. 1

Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 4.985 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 12.000 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 16.50 min
Total precip.	= 1.90 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 31,874 cuft



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Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

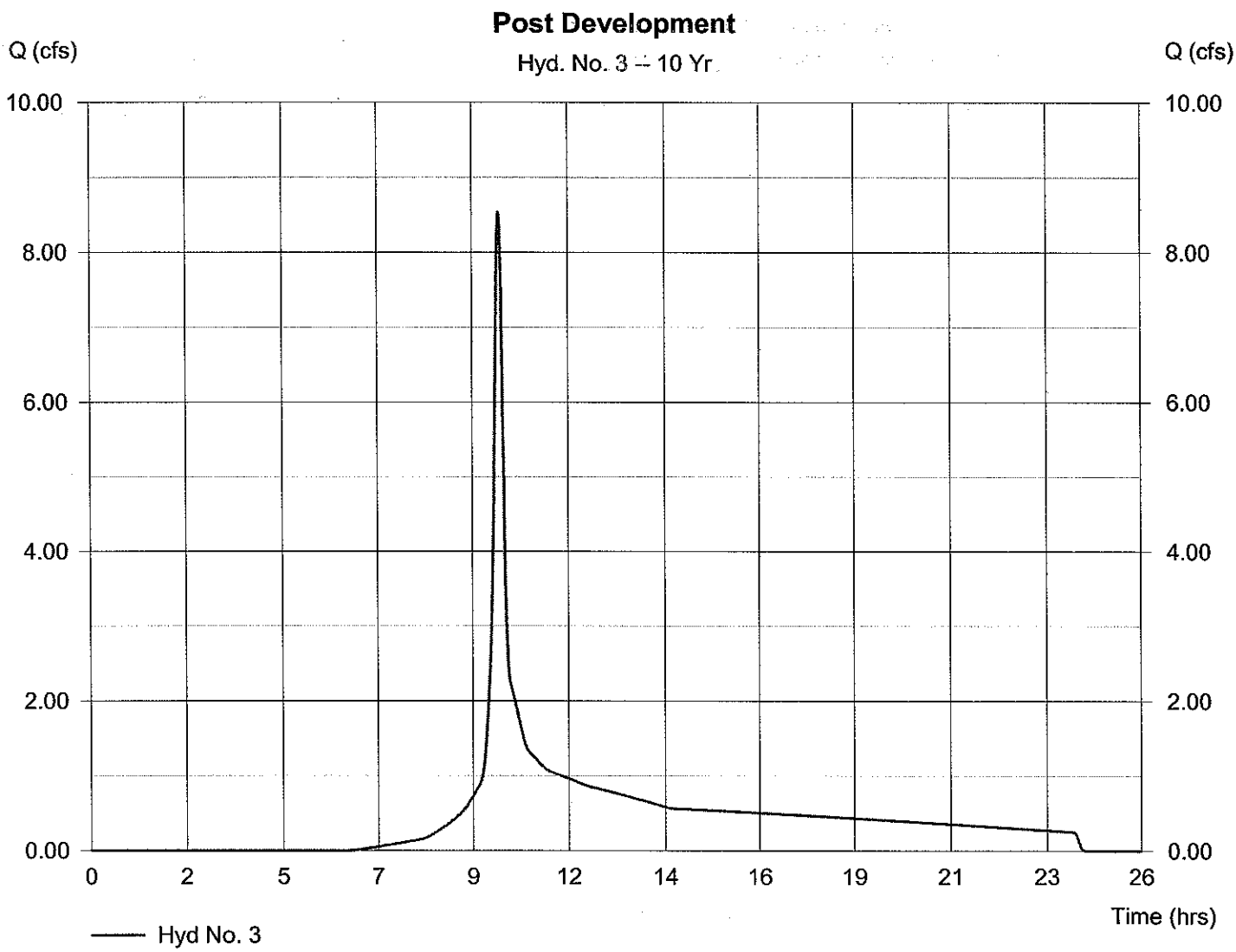
Wednesday, Sep 6 2006, 8:30 AM

Hyd. No. 3

Post Development

Hydrograph type	= SCS Runoff	Peak discharge	= 8.540 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 12.000 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.00 min
Total precip.	= 1.90 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 41,193 cuft



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Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Wednesday, Sep 6 2006, 8:29 AM

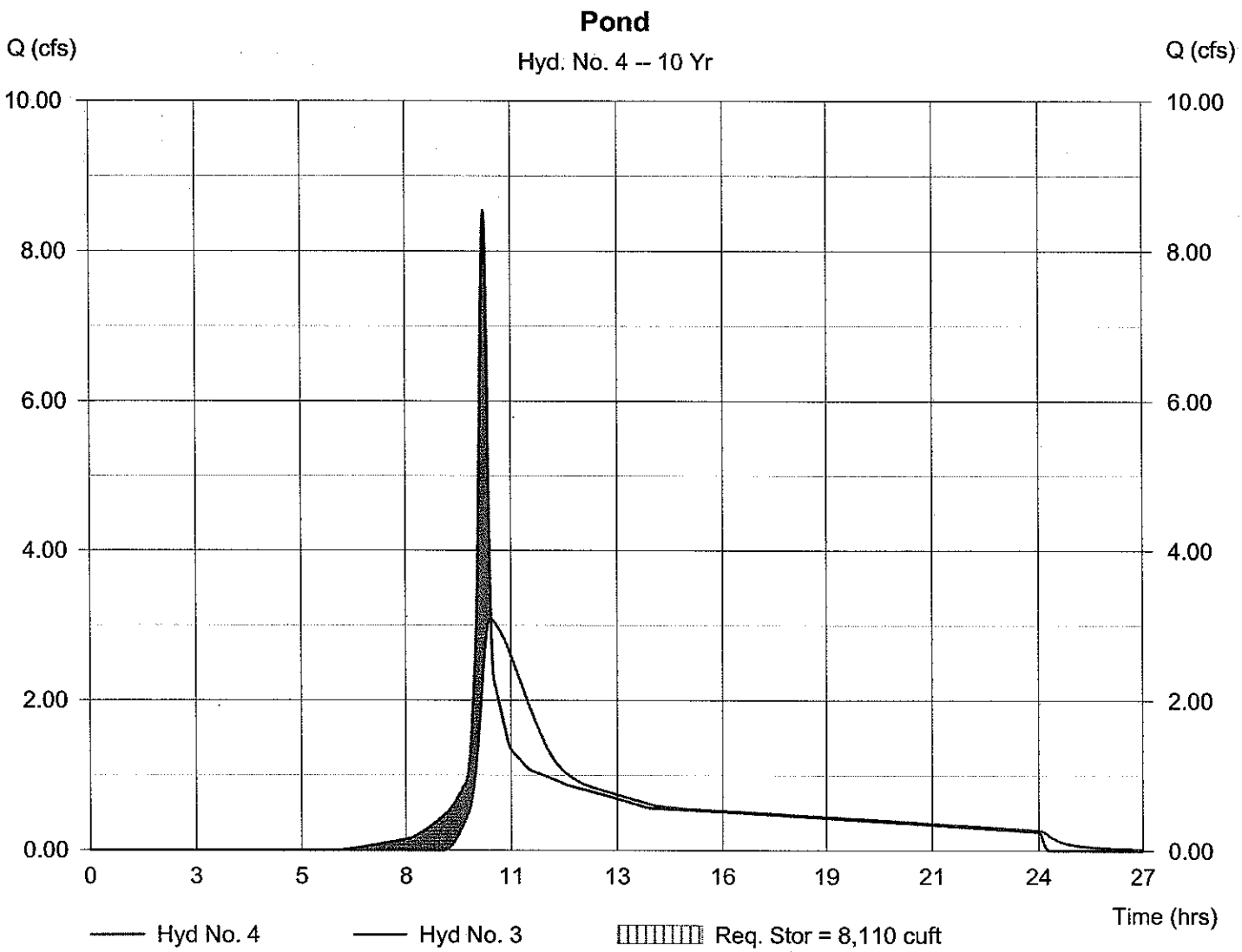
Hyd. No. 4

Pond

Hydrograph type	= Reservoir	Peak discharge	= 3.083 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 12.30 ft
Reservoir name	= Pond	Max. Storage	= 8,110 cuft

Storage Indication method used.

Hydrograph Volume = 39,801 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Wednesday, Sep 6 2006, 8:28 AM

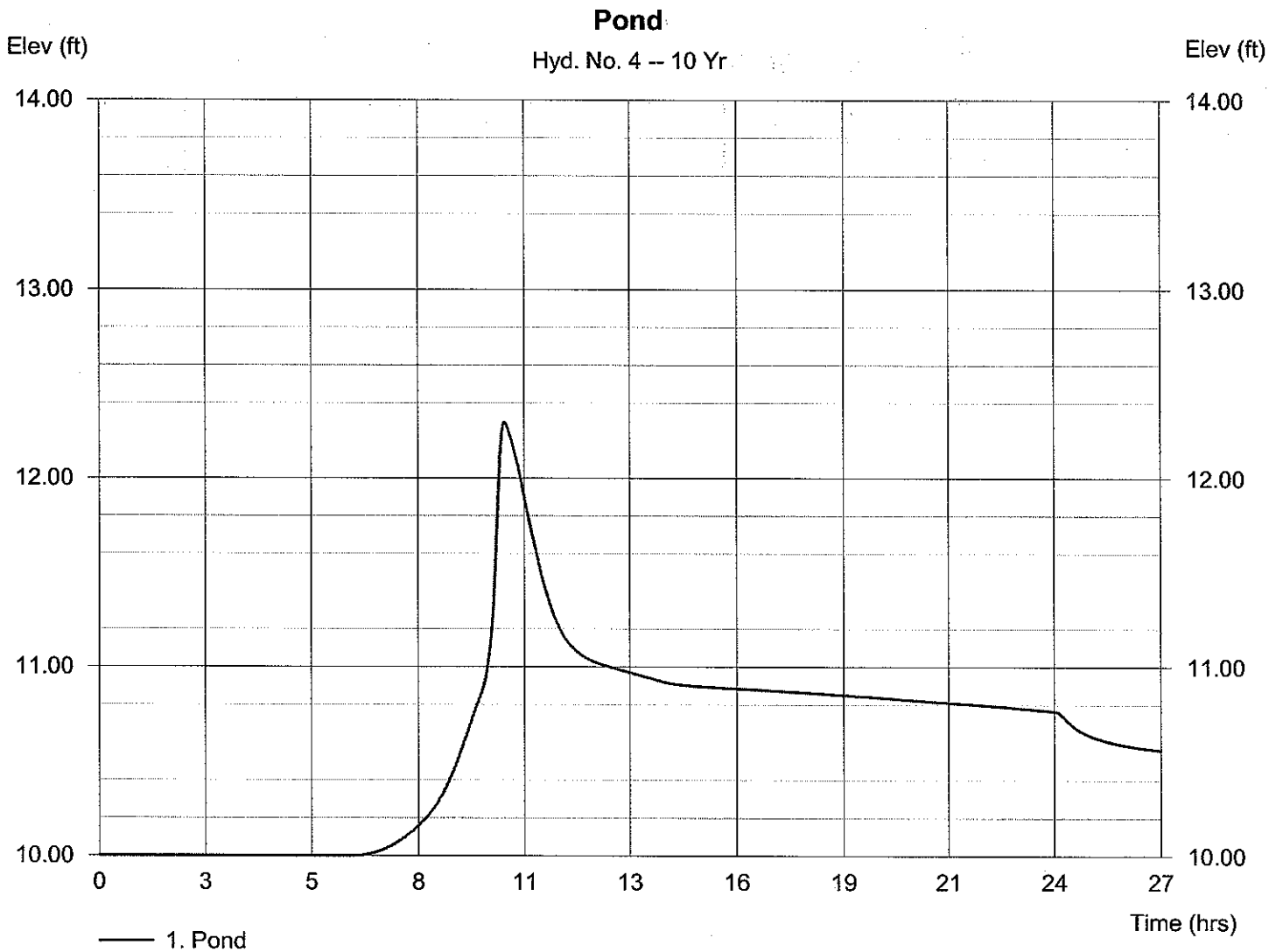
Hyd. No. 4

Pond

Hydrograph type	= Reservoir	Peak discharge	= 3.083 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 12.30 ft
Reservoir name	= Pond	Max. Storage	= 8,110 cuft

Storage Indication method used.

Hydrograph Volume = 39,801 cuft



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Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

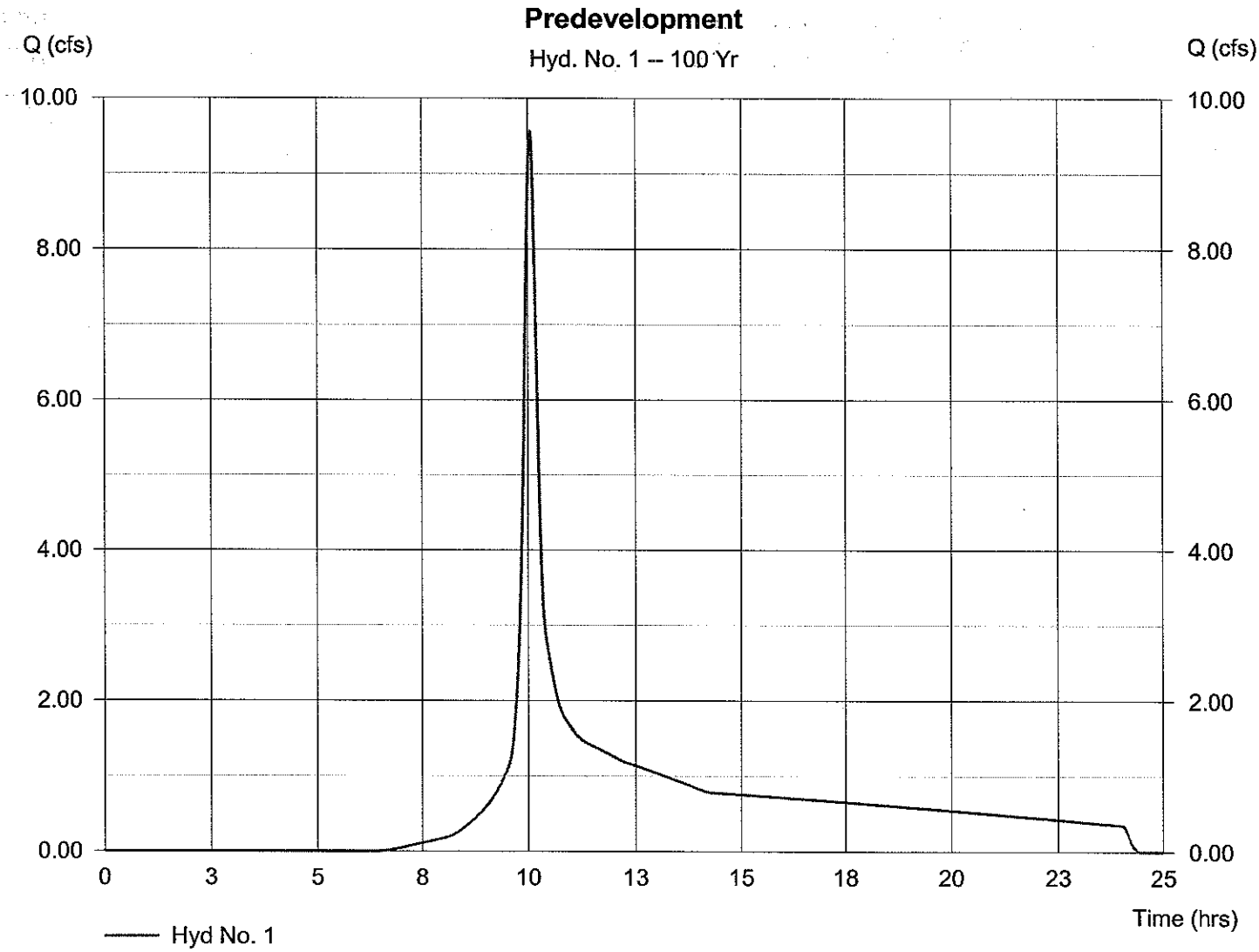
Wednesday, Sep 6 2006, 8:30 AM

Hyd. No. 1

Predevelopment

Hydrograph type	= SCS Runoff	Peak discharge	= 9.570 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 12.000 ac	Curve number	= 85
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 16.50 min
Total precip.	= 2.63 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 56,580 cuft



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Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

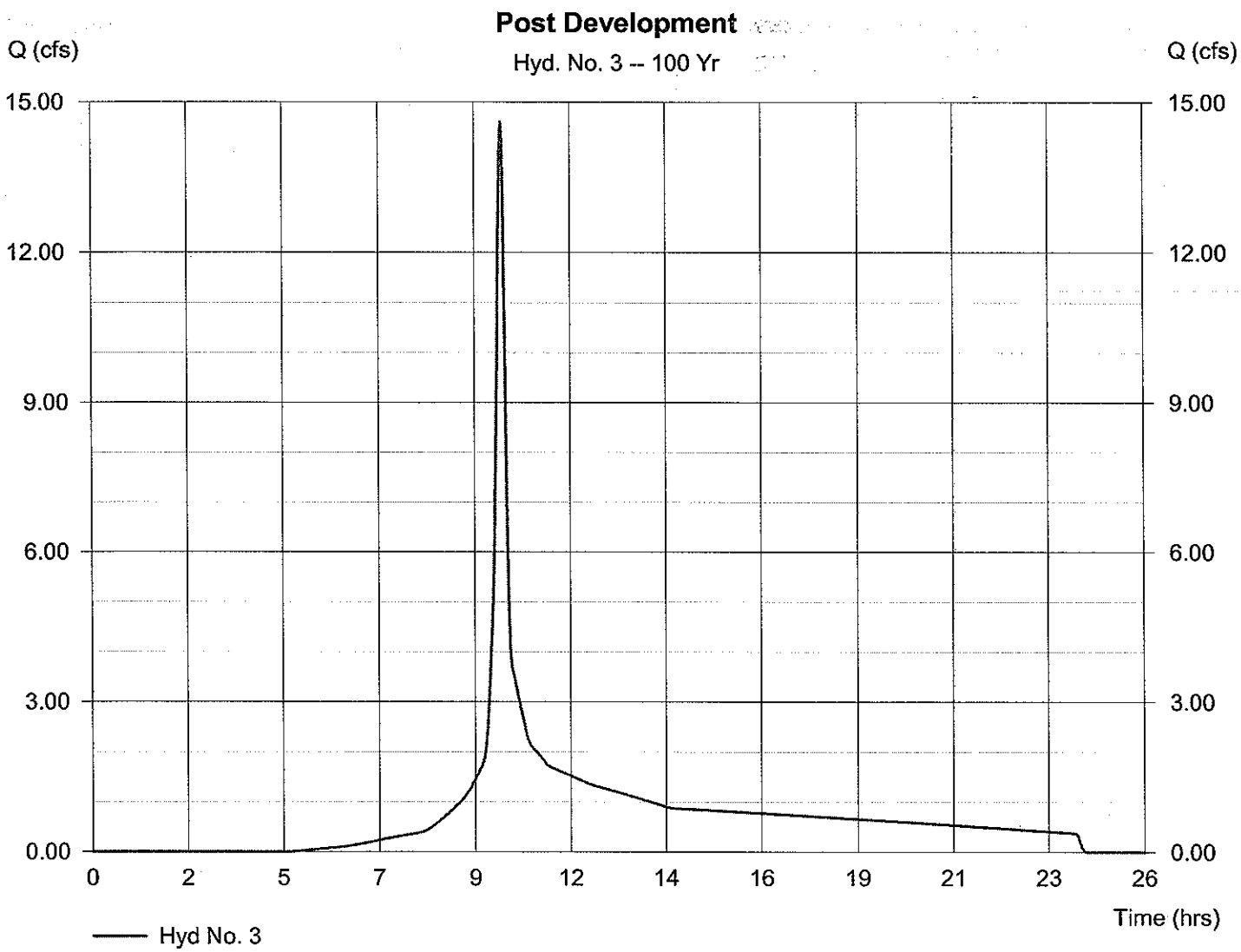
Wednesday, Sep 6 2006, 8:30 AM

Hyd. No. 3

Post Development

Hydrograph type	= SCS Runoff	Peak discharge	= 14.61 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 12.000 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.00 min
Total precip.	= 2.63 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 68,345 cuft



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Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Wednesday, Sep 6 2006, 8:29 AM

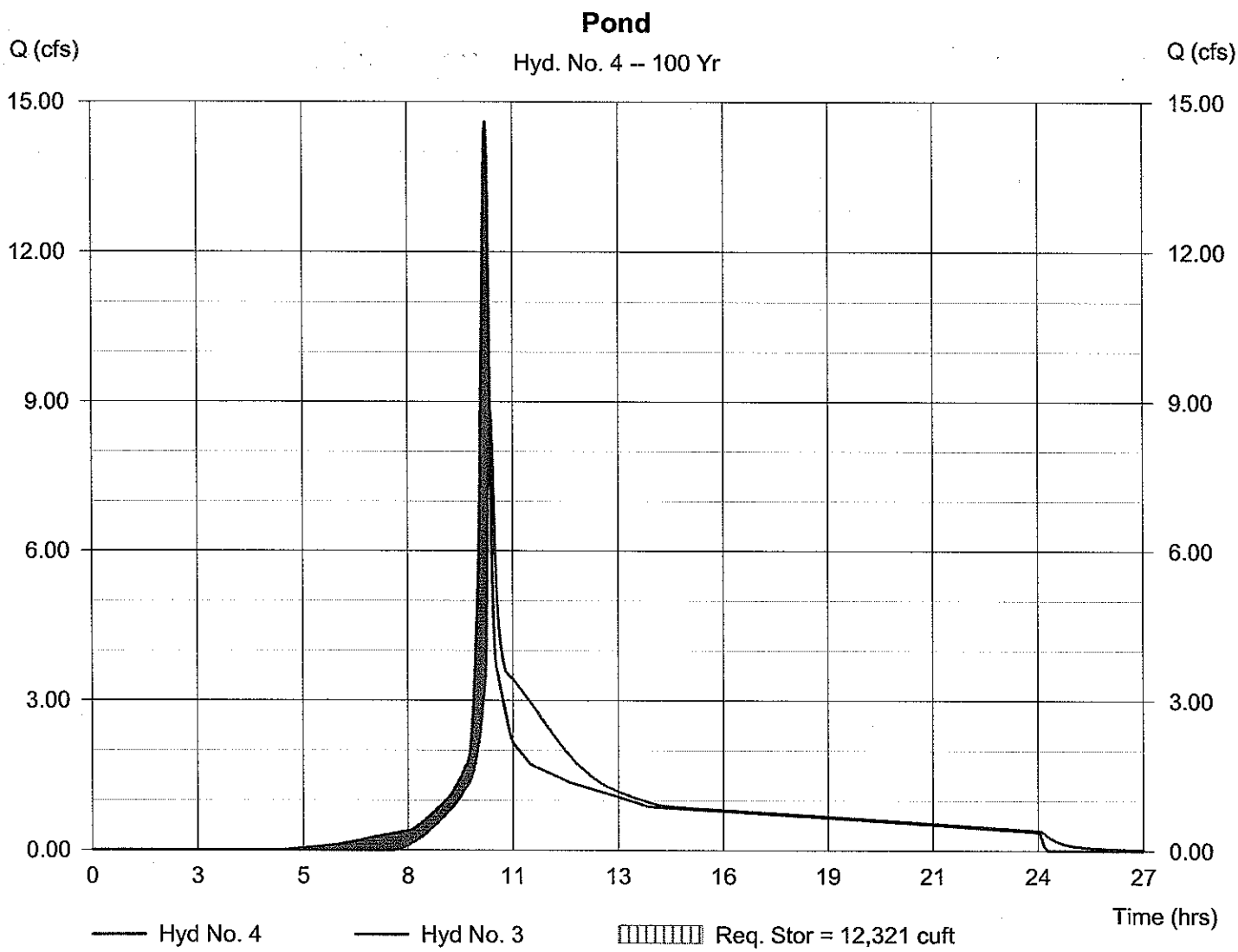
Hyd. No. 4

Pond

Hydrograph type	= Reservoir	Peak discharge	= 8.855 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 13.12 ft
Reservoir name	= Pond	Max. Storage	= 12,321 cuft

Storage Indication method used.

Hydrograph Volume = 66,953 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Wednesday, Sep 6 2006, 8:28 AM

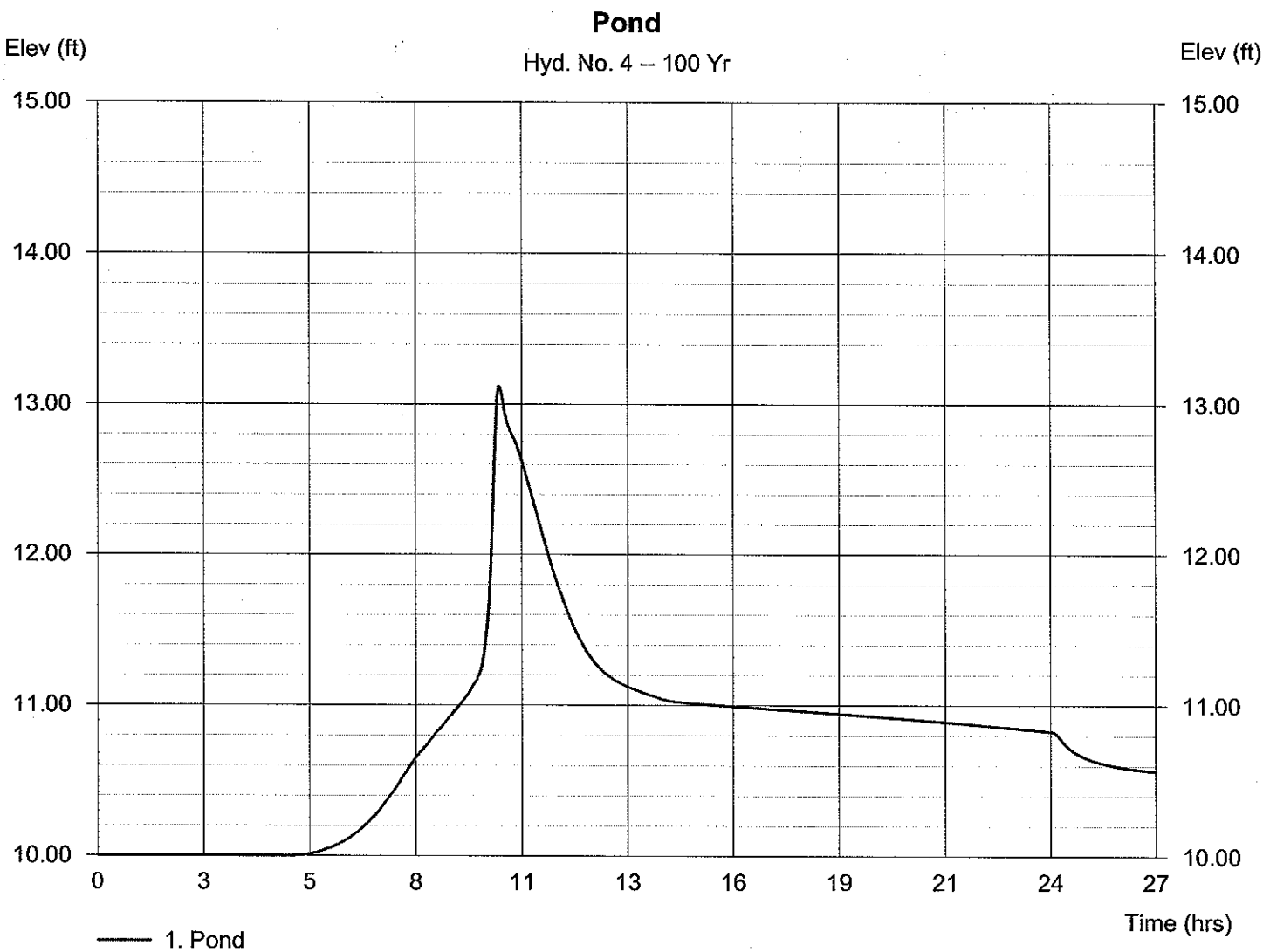
Hyd. No. 4

Pond

Hydrograph type	= Reservoir	Peak discharge	= 8.855 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Inflow hyd. No.	= 3	Max. Elevation	= 13.12 ft
Reservoir name	= Pond	Max. Storage	= 12,321 cuft

Storage Indication method used.

Hydrograph Volume = 66,953 cuft



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